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ABSTRACT

ISVOR (Societa di Sviluppo e Addestramento Industriale) was incorporated in 1978 as an independent organization owned by Fiat to provide all training services. In 1988, in the area of technical training alone, ISVOR offered 534 different training programs to over 29,500 participants, in a total of approximately 348,000 man/days. Four characteristics of ISVOR highlight its strategic role in training for new work technologies. To interpret the needs of today while anticipating those of tomorrow, ISVOR undertakes several layers of planning activities. It analyzes the impact of new work technologies on organizational functions, analyzes further training needs associated with these new requirements, takes into consideration actual job descriptions in each plant, and makes external and internal pressures compatible. Before formulating its consolidated training program, ISVOR takes into consideration the specific training goals of each plant, compatibility with the overall training strategy of the group, and capacity of the institution to mobilize resources to respond to the demand for training. ISVOR uses a flexible training system that consists of the following elements: an integrated training structure; modular approach to the development of training; client-based, flexible approach to training delivery; and incorporation of computer- and video-based technologies. ISVOR's staffing patterns and practices help ensure self-renewal. The profile of staff is basically technical, the job description is broad, and staff development policies play a critical role. The development of ISVOR raises two issues: the changing of training institutions and the new challenges high technology brings to education and training institutions. (YLB)

TRAINING discussion PAPERS

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Institutional alternatives for high-tech training: The case of ISVOR-FIAT

by João Batista Araujo e Oliveira

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by João Batista Araujo e Oliveira

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Foreword

There is nothing new about training institutions owned and operated by private corporations. There is also nothing new about the fact that training institutions owned by major corporations can become very successful and responsive to the corporation's needs, as illustrated, for example, by a number of case studies undertaken by the Work Institute of America (Rosow and Zager, 1988). Why then another case study on training institutions of this kind?

The uniqueness of this case relies on three major characteristics of FIAT's training institute, the Società di Sviluppo e Addestramento Industriate, ISVOR, and its relationships with FIAT which go beyond what we usually find. First, it illustrates how a major corporation managed to integrate training into its overall business strategy. In this case we are dealing with the highly dynamic automotive sector, and with a corporation which not only pioneered the automation of production, but was the first to install the most integrated automated assembly plant in Europe. The case essentially focuses on how the corporation dealt with training for high tech changes and with the role played by ISVOR. Second, the case shows how a training organisation conceived as an independent cost-centre, is able to maintain a balance between the advantages of access to intimate knowledge from the parent organisation while at the same time competing efficiently in the market place of training. In a sense, this is a discussion about the possibilities of changing training institutions - a necessity faced by many countries and corporations, and which is more often said than actually done. Well, FIAT did it, and apparently, successfully. Third, this is a case about the future of training for high tech. As education and technical training levels increase, as firms hire people with higher academic and technical background, as the workplace itself becomes a fertile ground for learning, is there a role for corporate-based trained institutions? The case uncovers ISVOR's strategies to remain flexible, and on the alert to adapt to the changing demands of today and tomorrow. This is achieved by frequent curriculum change, modular teaching, flexible delivery modes, and staffing policies which work as a sort of vaccination against obsolescence. Thus far, at least, such policies have been able to maintain the institution at the cutting edge of both work and training technologies.

The present case study was prepared as one of several inputs to a series of ILO's studies on the training requirements associated with the introduction of new work technologies. A separate case on the actual technological changes introduced at some of FIAT's plants has also been prepared (Oliveira, 1991). ISVOR represents FIAT's response to its perceived training needs to meet the challenges of introducing automation and other high tech machinery, tools and systems, since the late 1970's.

These two cases were based on a series of interviews held during the months of June-August 1990 at ISVOR and FIAT's headquarters in Turin, two of FIAT's high tech plants in Italy (Cassino and Termoli) and one plant in Brazil, as well as on the analysis of documents and publications. The case does not intend to present an evaluation of ISVOR, much less to recommend it as a model institution. Nonetheless, it is the author's hope that this analysis might provide interesting insights for those responsible for anticipating and responding to the training needs associated with the introduction of high tech production techniques in the workplace. No confidential information is released here. The author and the ILO are deeply grateful to FIAT, ISVOR and the Giovanni Agnelli Foundation for the staff time, access and the substantive inputs they contributed. All the opinions presented here, however, are the author's entire responsibility, and do not necessarily reflect the views of FIAT, ISVOR, the Giovanni Agnelli Foundation, or those of the ILO.

Executive summary

ISVOR - Società di Sviluppo e Addestramento Industriale - was incorporated in 1978 as an independent organisation owned by FIAT to provide the entire range of training services required by the various businesses of the group. It is expected to stay abreast of new work and new training technologies. It resulted from the consolidation of three previously independent training units, one of them dating back to 1922. The new consolidated organisation reflected the corporation's concern with the challenges of modernisation, automation, and introduction of high technology in the work place.

The major characteristics of the Institute analysed in the text are associated with its private, independent charter, which requires it to achieve full cost-recovery. While it has to be prepared to serve all of FIAT's training needs, it enjoys no exclusive rights to provide training: individual plants can secure training from anywhere. Even though the Institute has privileged access to inside information, each training proposal is analysed by individual plants (internal clients for ISVOR) and by FIAT's corporate training division.

The institute is also expected to sell some of its training services to external clients - up to 25% of its capacity. The reasons are less associated with economic sustainability and more with quality control. First, it serves to demonstrate efficiency, because it has to charge competitive prices. Second, it has to demonstrate quality and relevance by offering the high-tech courses that other corporations would be willing to buy. Third, through this mechanism, it exposes its staff and becomes exposed to the same constraints that characterise high tech firms, which involve a simultaneous strategy of cooperation and competition with suppliers, competitors and client firms - and thus stands to learn a great deal in this process.

The Institute offers a variety of courses, which can be delivered in a variety of formats, at the headquarters in Turin or at the client's plants. Modular training makes it possible to adapt the same programmee to a variety of clienteles, to different levels of instruction, and even to cater to individual needs. In 1988, in the area of technical training alone, ISVOR offered over 534 different training programmes to over 29.500 participants, in a total of approximately 348.000 man/days. Annual turn-over was about US$ 40 million, of which approximately 15% came from training for external clients.

A few distinctive characteristics of the internal organisation of ISVOR related to its capacity for self-renewal are the staffing process, the definition of professional roles, and the policy of professional development. Virtually all of the 100 full-time technical staff of the technology unit are engineers or professionals with technical background. These professionals are entirely responsible for all phases of the training process, from needs assessment and project preparation to training delivery and evaluation. Their activities are complemented by the intensive use of outside consultants. Staff are expected to maintain and update their knowledge of FIAT's production practices and training needs, and, at the same time, be informed about the current situation in their respective technical fields as well as in the field of training technologies and methods.

The outcomes and lessons discussed in the final part of the paper emphasise the relation between corporate and societal training policies; the division of responsibilities between educational and training institutions, on the one hand, and in-industry training, on the other; the merging of learning and doing, of training and work; and, consequently, the changing roles of corporate training institutions. Section I briefly presents the reasons for the creation of ISVOR and describes its structure. Section II introduces ISVOR's strategies and outcomes, while Section III analyses some of the general issues and lessons that can be drawn from this case.

I. The creation of ISVOR

In this section we briefly examine the history, the mandate and the organisational structure of the institute.

ISVOR was born in the context of a major reorganisation undertaken by FIAT in the mid-seventies. It was part of the corporation's response to labour unrest, of its adjustment policies to the second oil-crisis, as well as to the threat of the Japanese automotive industry. These factors led FIAT into the world of high tech. The resulting reorganised corporation is now formed by independent businesses, of which some are in Italy, and some abroad. In the automotive industry FIAT represents 50% of the Italian market and close to 25% of the small-car market in Europe (Automotive Industry Report).

The decision to consolidate existing training activities and to create an independent cost-centre operating on a full cost-recovery basis corresponded to the overall reorganisation policy. The decision to orient this new organisation towards high-tech training was related to the perceived - but yet not entirely clear - need for intensive training and retraining of the work force which would derive from the introduction of automation and other high-tech production machinery and systems then envisaged. Thus ISVOR was created as a response to the new organisational strategies, to the technological changes envisaged, as well as to the emerging training needs associated with the introduction of new work technologies.

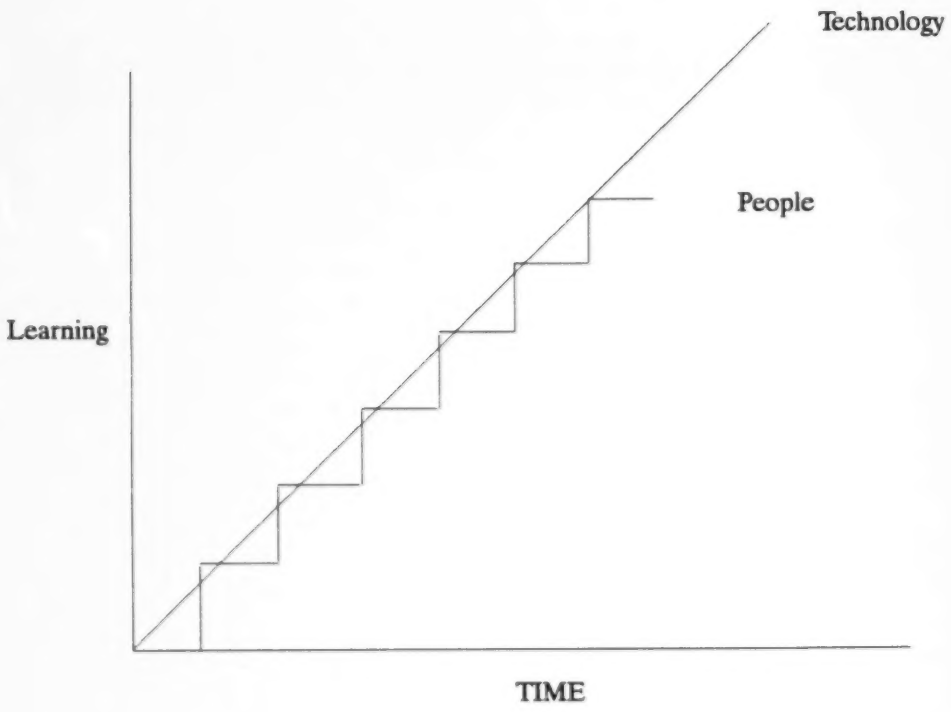
ISVOR was not created in a vacuum. It was formed out of three existing training activities which were merged: The Giovanni Agnelli Vocational Training Centre, operating since 1922; the Supervisory Training Centre, which was basically focussed on supervisory training for labour relations; and the Institute of Organisation Development, previously in charge of management development. From these past experiences it inherited knowledge of clients' operations and needs, as well as the ability to informally reach all levels of the organisation on the basis of which it could extract critical information for its operations.

But ISVOR was created to be innovative. Before introducing new technologies in the workplace, FIAT's engineers embarked on a number of studies and projections - sometimes mere conjectures - of future configurations of the workplace - and the impact these would have on training requirements. A report prepared by the Giovanni Agnelli Foundation (Uberto and Cerato, 1983) takes stock of past reflections and delineates the conceptual and practical implications for training and for the organisation of the workplace to be expected from the introduction of automation.

The learning curve of new technologies presented a new challenge - to which ISVOR was created to respond. A major departure from past training practices was required by the new concept of timing of training. Figure 1 illustrates the concept. In the past, training and learning occurred by discrete stages. Theory preceded, exceeded and was often more or less removed from practice. This pattern did not present a major problem - people would have time to adjust on the job. But the world of high-tech is different. Technologies evolve - but not in the abstract. They evolve through people - and can only be conceived, adapted and used by real people engaged in real-time production. The technologies that matter for industrial competition are those in the making - not those in textbooks. Technological progress is not step-wise - there is no more time to stop and rest. It is linear - actually exponential, as suggested by Figure 1. Technological know-how creates a new reality for training:

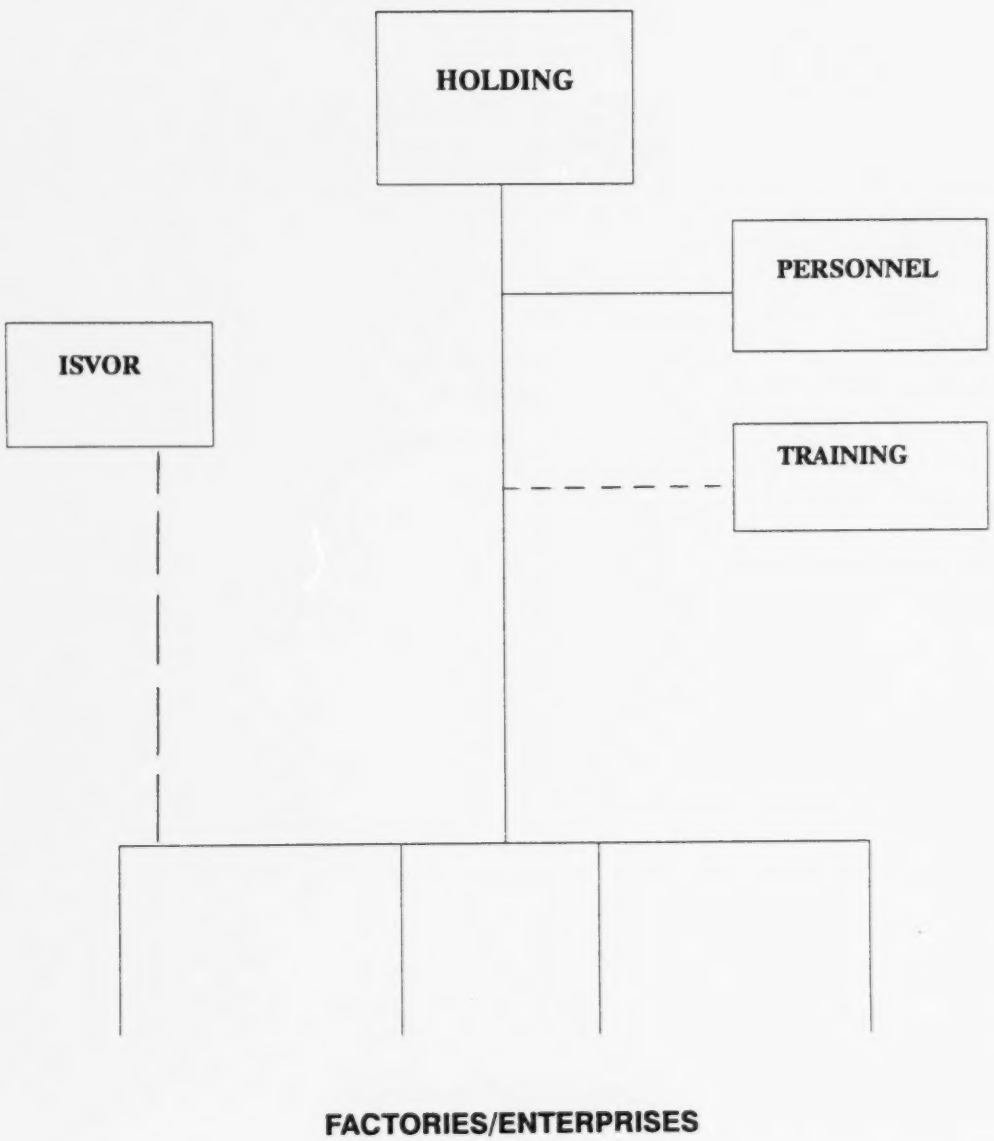
knowing and doing come closer together, existing knowledge seems to be always less than necessary. Thus, training would have to be provided on real time, to avoid knowledge gaps. Not a trivial challenge for an emerging training institution.

Figure 1



ISVOR's mandate was to produce training compatible with present and future needs of the corporation's new industrial strategies, which called for a progressive automation and integration of manufacturing. It is considered as a service company for the entire group. Several levels of interaction exist between ISVOR and the corporate planning, normative and operational units, as illustrated by Figure 2.

Figure 2

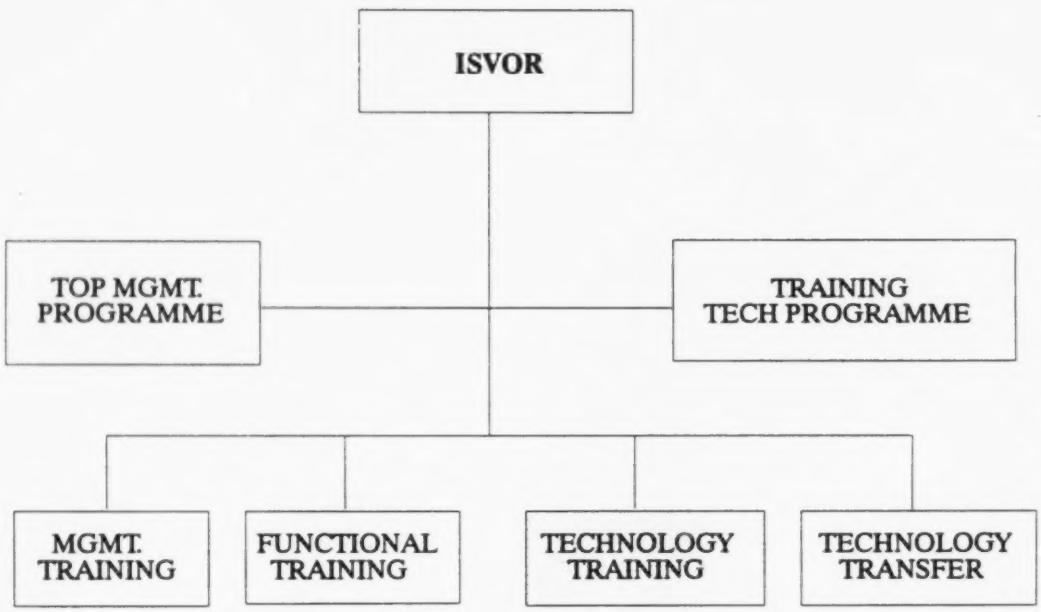


At the policy and strategic level, these links are guaranteed by the corporate structure of ISVOR, whose board is formed by representatives of the various sub-holdings of FIAT. Even though ISVOR is an independent organisation, it receives guidelines and follows the general strategies set up by this group. At the programming level, ISVOR is accountable to the training unit of the entire corporation. At the operational level ISVOR interfaces directly with the plants, both in formal and informal ways. Finally, to complete this network of inter-relationships, some of ISVOR's directors are also directors of other units of FIAT.

II. What ISVOR does, and how

This section describes the strategies underlying ISVOR's activities. It concentrates on the Technological Unit of the Institute, which is the one in charge of technical training (Figure 3).

Figure 3



Overall, the Technological Training Unit occupies a building of 25,400 square metres, with 15,000 square metres of shops, 39 classrooms, 1 auditorium, 2,200 square metres of offices and 4,200 square metres for the remaining infrastructure. Besides, outside training facilities are also rented on as needed, while some training is also performed at clients' plants.

ISVOR mimics FIAT's culture and operating rules, including those pertaining to support infrastructure and security. Training is considered as real work as far as faculty and trainees are concerned. Faculty and students follow the same work schedules as in the other plants or units of the group. The workshops have the same types of equipment used for production in the factories, which minimises

the problems of transition from training to work.

Four characteristics of ISVOR will be analysed to highlight the strategic role it plays in training for new work technologies. First we will try to understand how the Institute interpret straining needs and transforms these into its curricula and course offerings. Second, we describe ISVOR's strategies concerning training design and delivery by emphasising the flexibility of such strategies. A third section analyses a critical issue for training institutions, namely the staffing patterns and practices which help ensure self-renewal. Finally some results, cost figures and financing practices are presented, to illustrate possible ways to evaluate the effectiveness and efficiency of such institutions.

A. Planning

ISVOR is responsible for identifying concrete needs in FIAT's plants, but at the same time it must help individual plants and the corporation as a whole to anticipate and be prepared for technological changes. In other words, it should know how to interpret the needs of today while anticipating those of tomorrow. This is the purpose of planning. To accomplish this task, several layers of planning activities are undertaken on a regular basis, as described below.

At a broader, more general level, ISVOR must analyse the impact of new work technologies on the various organisation functions, regardless of the present degree of factory automation. The forecasting of such training needs covers all the workers directly or indirectly involved in production activities. Figure 4 illustrates the more general trends that emerge from such exercises, and which provide a first approach to structuring the training programme.

Figure 4

Knowledge required at the various professional levels

• **Direct workers**	Traditional values and skills relevant for the industrial culture (plus quality concerns)
• **Operators**	Basic technological concepts; knowledge of plant and machine-specific operations
• **Specialised maintenance**	Specific specialised knowledge (mechanics, electricity, electronics, pneumatics,lubrification, automation,etc.)
• **Polyvalent maintenance**	Integration of specialised knowledge
• **System designers**	Integrated knowledge of basic technological concepts plus specialisation in specific areas plus CAD/CAM
• **Production support**	Basic knowledge of the new work organisation plus specific knowledge of specialisation

Note: Workers at all levels also need to master specific informatics-related knowledge and skills (Rossi, 1987, p.7).

A second step consists of further analysing the training needs associated with these new requirements, for the various categories of workers. For a same topic, different levels of information and proficiency will be required, according to this category, as illustrated in Figure 5. These levels are modulated on a scale which ranges from basic proficiency, technological or technical updating, professional reconversion to in-depth specialisation. For example, the same course on economics or CAD-CAM can be modulated to serve the specific needs of these various client groups.

Figure 5

Targeting training

Targets/Issues	Operators	Engineers	Managers
Goal	Re-skilling	Reconversion	Cultural change
Content	Basic/qualified	Basic and high tech	Cultural/Language Technical briefings
Duration	Medium	Short	2-3 day seminars

The third step takes into consideration the actual job descriptions in each plant. This exercise needs constant review and updating, given the introduction of new work technologies and the redesign of jobs which often comes with it. To some extent this becomes a circular, self-reinforcing mechanism: the existing pool of skills determines the design of the jobs, but also the training requirements; an increased pool of abilities (through recruitment and training) allows for a different strategy of job design. Thus, job design might change as a function of the training of the workforce, and thus feeds forward into the training system.

Since the analysis is specific to concrete jobs, the risks of overtraining become minimised. Take the case of the polyvalent technician, for example. An ideal profile exists throughout the corporation concerning the ideal profile of the multi-skilled, polyvalent worker of the future, sometimes called a mechatronic (ILO/APSDEP, 1988). This could be an operator taking on some responsibilities for maintenance and quality control. Or vice-versa, a maintenance technician also performing operational jobs. Or a maintenance specialist increasing the ability to simultaneously deal with different specialisations, such as mechanics, electricity or electronics. But it also means the ability to deal with theory and practice, in the office and in the workshop. At some point in the future it is expected that at least some workers will be able to perform a range of functions which are traditionally separate

This is the theory - a blueprint for the long run. In practice, and in the short-term, technicians progressively incorporate new abilities - and this depends on a number of variables such as level of technological development of the production line, type of plant, timing of training, present level of education and training of the worker, production targets for a given year,

budget, etc. It is a function of ISVOR to understand the stage of development of each unit - and modulate its course offerings to provide only the types and levels of training that can be absorbed in the short term. This is a dialectic process, in which ISVOR has to sell the corporation's long term view, and where clients can barely afford to pay to upgrade their staff for their short-term needs. After all, training costs add to the overall production costs - and FIAT must compete.

The fourth level of training needs analysis is even more complex than the previous one. At this stage, ISVOR needs to make a number of external and internal pressures compatible. General needs deriving from societal and technological change have to be taken into account. For example, in the new industrial world of high tech, technical workers, including operators, need to know at least some basic elements of economics - they will have to take decisions concerning production flows. Every worker, including non-skilled ones, also needs some training in quality issues. Specific needs of the corporation must also be considered. For example, the organisational culture, the transmission of the basic values of the organisation - and its practical implications for work discipline, incentives, quality, image of the firm, etc. have to be taken into account. Specific needs of new work technologies are also incorporated in the overall planning exercise. For example, technical and office workers are now required to be literate in computer related skills. The long-term interests of the firm also need to be considered in the structuring of training programmes. For that, the broad-based technician will eventually need some basic or upgrading courses, and ways must be found to incorporate this knowledge in technicians' work - through job enrichment or other arrangements.

Before formulating its consolidated training programme, ISVOR still needs to take three considerations into account. First are the specific training goals of each plant - which are determined by local contingencies such as work plans, production targets, budgets, and the profile of the existing workers - including their individual interests. After all, this is the bottom line, as far as demand is concerned. The second consideration is the compatibility with the overall training strategy of the group, which is achieved by consultation with the corporate training unit. And finally, it must take into account the capacity of the institution to mobilise its resources and that of outside consultants to respond to the aggregate demand for training. Figure 6, below illustrates the types of course offerings planned for 1990 on the basis of these considerations, and which reflects the consolidation of the inputs discussed in the previous paragraphs.

The annual training catalogue, however, is not a mirror image of the work plan actually delivered by the end of the year. Even though the backbones of the programme remain more or less unchanged in a given year, actual implementation tends to depart by 20 to 30% from what was planned, given the changes in the environment, as well as changes in the production schedule and other emerging or unscheduled training needs of individual consumers of the training, including new developments coming from R&D units. Micro-planning and changes in course delivery have to be kept highly flexible, to respond to the changing needs and plans of the clients.

Courses vary from 2 to 50 days, but a typical course takes from 25 to 30 days. Seminars and other updating opportunities are short, ranging from 1 to 3 days. Modulation is provided through the extensive use of flexible training technologies such as video-disks. Each course can be modulated to serve the needs of different client groups, or even, individual trainees. Thus, the same course can be offered at different levels, or parts (modules) of different courses are combined in a new course, according to demand.

Figure 6

Catalogue of courses, 1990

Types of courses	Number of courses
New courses on technological innovation	29
Seminars (informatics, high tech, etc.)	35
Technical courses	
• Electronics	21
• Electricity	21
• Pneumatics	13
• Mechanical maintenance	17
• Technology of Stampaggio	6
• Welding	7
• Repair & maintenance	10
• Tracciatura	12
• Machine tools	19
• Technical drawing	4
• Work organisation	14
• Robotics	26
• Energy	3
• Risk & security	9
• Integrated course for operators	1

(adapted from ISVOR Catalogue, 1990)

The work programme is also affected by the technological progress of the group. As new work technologies are absorbed and the FIAT group becomes more technologically mature as a whole, new training needs emerge, requiring a dynamic adaptation. Figure 7 illustrates how the emphasis of the ISVOR programme has been changing over time. These changes reflect both the effects of previous training as well as the requirements of new work technology being progressively implemented in the various plants. As basic training is completed at one plant, training needs concentrate on higher levels and integrative types of training. At any one time, however, various types and levels of training are required, and need to be provided, as illustrated in Figure 7 below. The year 1988 shows an increase in specialisation and automation courses, and a decrease in basic training - and this seems to be the trend for the future.

Figure 7

Changing Emphasis of Training (%)

	1978	1982	1985	1988
Basic training	80	55	35	20
Qualification	20	39	44	40
Hi specialisation	--	- 6	19	25
Automation	--	--	2	15

B. A flexible training system

ISVOR is expected to reflect and disseminate FIAT's corporate and technological culture. Thus, its invisible curriculum - the way it imparts training - is at least as important, if not more - than the actual contents of the training delivered.

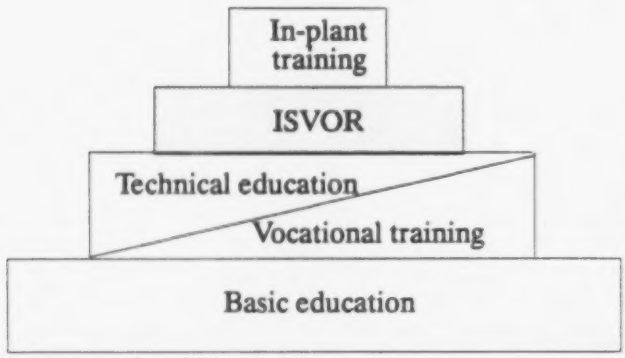
The Institute attempts to accomplish this mandate through the concept of a flexible training system. This is a concept parallel to that of flexible manufacturing systems characteristic of the fully automated factories being implemented by the FIAT group. The concept of a flexible training system is reflected in the way the Institute defines its goals, as analysed in the previous sections, its staffing patterns -which will be analysed later - and in the ways it structures its programmes and training technologies, which are discussed below.

The term flexible training system (Rossi, 1987, p.15) was coined to illustrate the Institute's capacity to deliver a timely, flexible training response. This approach consist of the following elements:

- an integrated training structure
- a modular approach to the development of training modules
- a client-based, flexible approach to training delivery
- the incorporation of computer- and video-based training technologies

An integrated training structure. The experience of ISVOR confirms the commonly held idea that new work technologies require increasingly higher levels of academic and technical education and training. The supply of manpower by the education and training system inside and outside FIAT is illustrated in Figure 8.

Figure 8



Virtually all of the new employees hired by FIAT for production areas in recent years have completed 8 years of basic education plus some form of vocational or technical training. But this is not the case of the majority of the existing workforce, in which ISVOR invests a great deal of training and retraining efforts. This is part of the transitional stage in which most high tech firms find themselves, and which requires not only massive doses of training, but the coexistence between a new - more educated and trained, but less experienced workforce with an old workforce with more experience, but less formal education. The problem with high tech is that experience can no longer be traded for knowledge, hence the need for formal training. This is a typical case in which a corporation is attempting to deal with the technologies of tomorrow by using the workforce of today.

In the future, the situation might be dramatically different - and so will the functions of an institution like ISVOR be. In the present stage of transition, the corporation is heavily investing in training - as indicated by the direct and indirect training expenditures before and after the implementation of new automated plants. Operators, for example, were trained in courses varying from 5 to 13 months - and technicians receive intensive training of various durations. This is a major departure from past practices, and represents one of the strategies to integrate the present workforce into the world of new technologies.

Regarding the integration of the workforce of tomorrow, i.e, the new recruits coming directly from the educational system, FIAT expects graduates with a general ability to learn, a basic understanding of science and technology and, in a few cases, mastery of technical or vocational skills. Introductory training, however, does not become less necessary than in the past. Quite the opposite - it currently lasts for 20 to 30 weeks - and includes a number of topics now considered as basic skills for the new work force. At FIAT, these include a knowledge of the evolution of car-making, introduction to economics and quality control techniques, new production technologies, productivity and the role of unions and the workforce as well as firm-specific information.

Rather than waiting passively for the educational system to interpret the corporation's expectations, special programmes exist to inform teachers about transformations in the workplace.

The enterprise goes to the school: integrating education and training?

FIAT understands that it is part of its corporate responsibility to inform the school system about changes in the world of work. Special programmes exist to inform and sensitise teachers in the school system about new work technologies and their impact on society, in general, and in the organisation of the work in the factory, in particular. In 1990, for example, virtually all of the 25,000+ teachers of the Turin school system were involved in 2 day seminars sponsored by the Giovanni Agnelli Foundation to discuss such issues.

The major objective of the programme is to invite teachers to critically understand technological changes and their effects on society. The expectation is that teachers will introduce such discussions in their classes. There is no specific attempt to ask teachers to teach this or that topic - not even to teach more science or technology-relevant courses. What the programme expects is that teachers and students will know more about the realities of the modern industrial corporation and its relationships with society. There is also another meaning to integration, and this is perhaps one of the Institute's major features. Its main function consists of integrating theoretical and practical experiences through formal training opportunities. The approach adopted can be better illustrated by contrasting it with traditional training, as illustrated below (Figure 9, from Rossi, 1987, p.10).

Figure 9

Integrated vs. traditional courses

Traditional Course	Integrated Course
• Divided into disciplines, highly fragmented	Less fragmentation
• Difficult, complex to learn	Technological arguments presented on a timely basis, facilitating comprehension
• Students must make the effort to integrate	Scientific and technological knowledge, theory and practice arguments coordinated successively
• Theory and practice taught by different teachers with different cultures	Interdisciplinary intersections carefully planned and delivered

The relationship between the Institute's staff and clients in the plants make it possible to design and implement training programmes which are not only integrated in the sense described above, but also directly integrated into the realities of the workplace.

A modular approach to the development of training modules. Once developed on the basis of the integrated structure described above, course contents are divided into learning modules, for which appropriate instructional materials are developed. The modules contain not only the technical description of the course contents and information about the clientele and pre-requisites, but also include the actual materials that are to be used by the instructors or trainers.

One of the characteristics of ISVOR's modularised approach is to develop materials which can be used for a variety of audiences. For example, a CAD/CAM course is designed in such way that some general portions can be used by managers, technicians and operators, while other units are only used for specialised training. The modularised approach also permits the consolidation of integrated courses using modules from different specialties. Figures 10 A and B illustrate how the training programme for two courses, one for operators, and one on factory automation is developed, on the basis of existing modules.

Figure 10A

Courses for operators

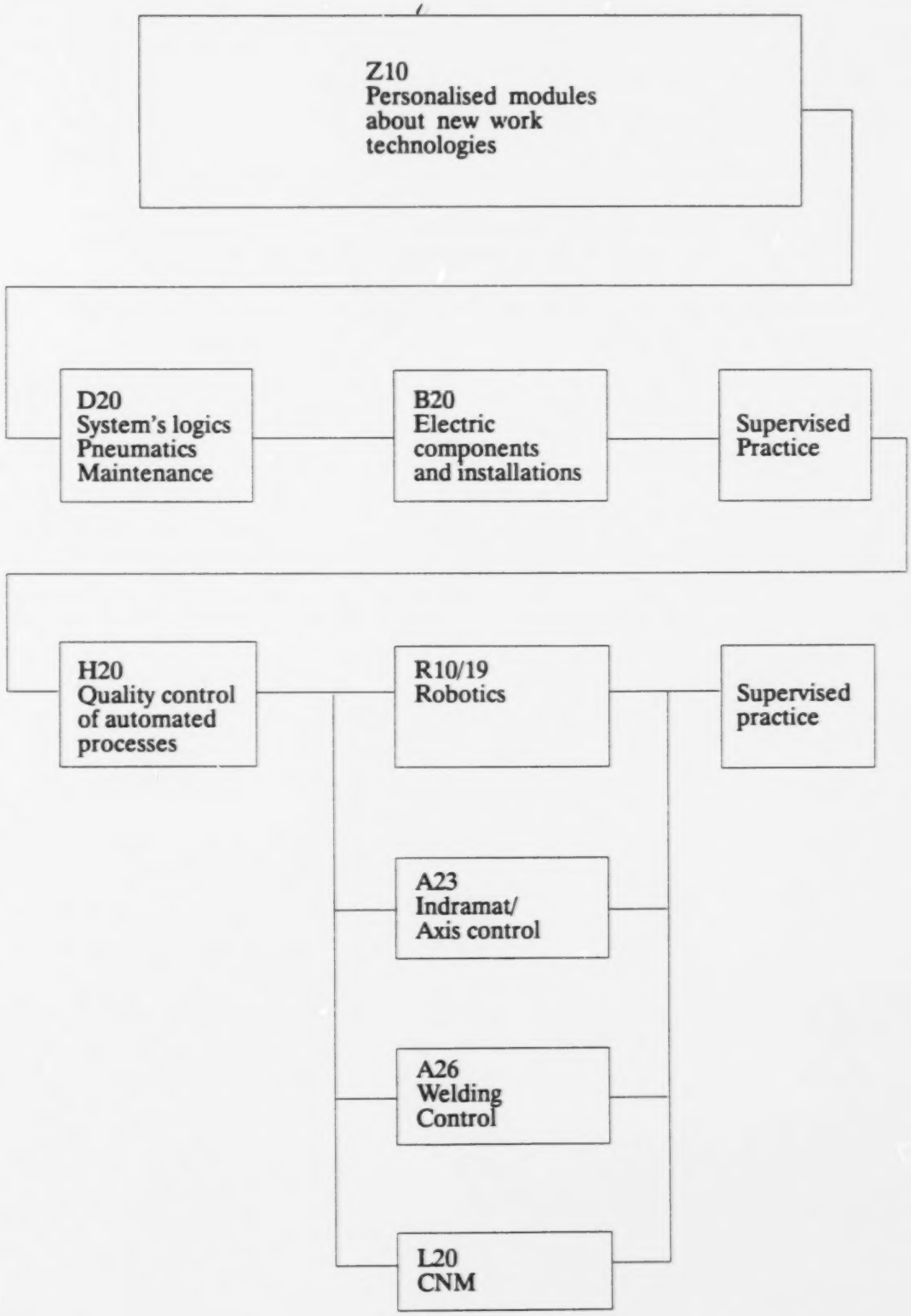
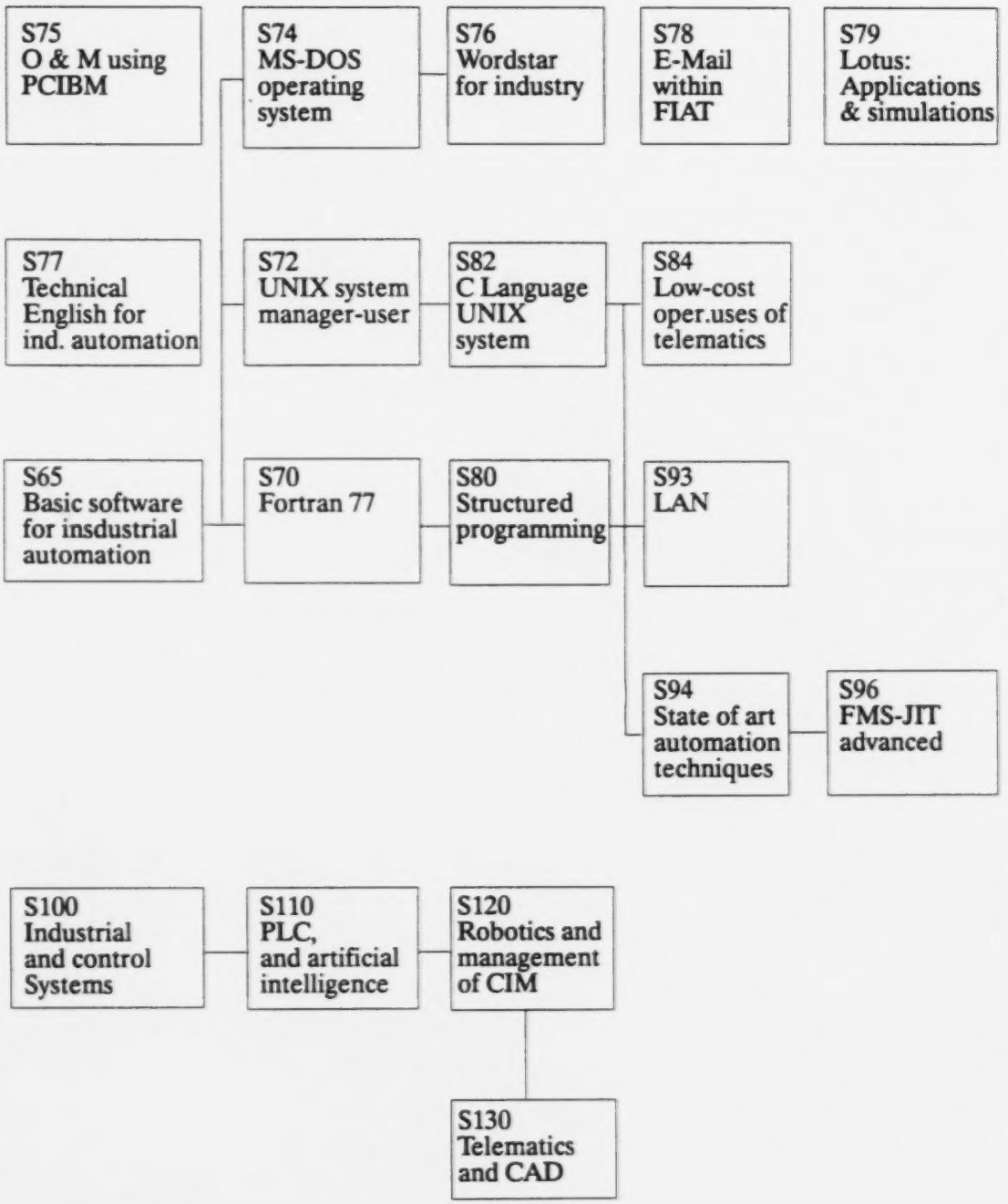


Figure 10 B

Factory automation courses



The modular approach illustrated above has at least two important meanings. First, courses are broken down into discrete units, which can be offered in a number of flexible ways (in space or in time). But courses are also modularised in different levels of complexity, to serve the different needs of the different clientele. A third meaning of the modularisation, i.e., delivery systems, is described in the next topic.

ISVAOR has a client-based, flexible approach to training delivery. The majority of ISVOR training is delivered at headquarters. A typical course consists of 40% classroom work, 30% laboratory work and 30% through simulation of job situations or supervised practice on the job.

Organising and supervising on the-job-training can be a very complex task. For example, new operators being trained for the automated plants at Termoli were supervised by technicians from the maintenance crew teams. These technological teams were previously trained by ISVOR. Since these operators came from very different backgrounds, individualised, modularised training had to be offered. Training this heterogenous group to master the various new functions illustrated in Figure 10 A varied from 5 to 13 months, according to each individual's backgrounds and needs.

The Institute also offers other kinds of delivery modes, such as turn-key training projects, as was the case for the two new factories at Termoli and Cassino. In both cases training started well before installation of machines, and most of the basic training was provided by ISVOR before operations started.

Training by suppliers is a major characteristic of the world of high tech. To perform adequately, maintenance technicians, in particular, need to understand the logic of individual machines and how they work. Thus, the best training comes from observing and participating in the production, assembly and installation of the machines and tools they will be responsible to maintain. Suppliers of equipment and tools often include training as part of their selling package, but seldom are they ready to deliver their promises. To some extent, particularly in the case of custom-made machines, one of the difficulties is that manuals and other technical specifications are written only after the machine is actually produced. Other reasons have to do with the increasing cost of the product, when training is added (see Rosow and Zager, op. cit. for a discussion of similar problems in the U.S.).

When confronted with such problems, ISVOR was able to help COMAU - a machine-tool manufacturer subsidiary of FIAT - to organise and deliver such indispensable training. The institute designed a training programme with COMAU and helped to implement it through its staff. This is another way in which a training institute can increase its flexibility to help in the training capabilities of suppliers.

A necessity was the incorporation of computer-based training technologies. ISVOR incorporates most of the existing training technologies in the training courses. Training coordinators are responsible for choosing training technologies based on the adequacy of the technology to the purposes of each circumstance. ISVOR is not particularly committed to any training technologies or approaches. Conventional teaching cohabits with the most advanced training technologies, such as individualised instruction or interactive video-disks.

In many cases, the use of computer-delivered instruction is directly related to the contents of training. Techniques such as CAD/CAM, FMS can only be learned by interaction with computers - using simulators or the same computers and machines used for real-life production.

In other cases, the use of modern training technologies is justified for other reasons: we cannot run the risk of not using them, according to one interviewee. According to him, training technologies such as videodisks, for example, still hold more promise than they can deliver. Living in the world of high tech, ISVOR knows that it takes time to learn about any technology,

including training technologies. Since such technologies can have an important impact in the future, a serious training organisation committed to technology training needs to keep as much flexibility as possible through experimenting and using them all. A CAD/CAM project using CBT and video-disk, for example, was developed by ISVOR, under the sponsorship of the European project COMETT, and in collaboration with outside partners, one of which was outside Italy. ISVOR provides the subject-matter expertise and the laboratories, while other partners contribute the specific know-how necessary to produce video-discs.

Training technologies are also used for practical reasons. The training of new technical workers - about 300-400 youths every year, representing about 15,000 training weeks per year - requires a mixture of instructional inputs, where CBT and videodisk play a major role. Four major reasons are invoked for the use of such technologies: standardisation of contents; flexibility of delivery; motivation of new workers, since they can start with any of the subjects included in the curricula, according to their preferences; and the need for cost-effective delivery, given the high number of students. Apparently the existing programme meets these criteria.

C. Staffing policies and practices: avoiding obsolescence

The critical asset of a training institution is its trainers. We analyse below the most distinctive characteristics of ISVOR's staff: the profile, the job and the policies concerning staff development.

The profile of the staff is basically technical: virtually all instructors in the Technology Unit have a technical background. Most of them are professionals with profound knowledge of the organisation; some are recruited from the outside, to fill in positions where internal expertise is not available. Most of the training activities are performed directly by the staff, with the assistance of external consultants. In 1988, for example, ISVOR hired 420 consultants on contracts of various durations.

The description of the job is very broad, and encompasses the combined functions of a planner, course designer, trainer and manager. The typical professional staff member at ISVOR is a course coordinator. He is involved and responsible for all phases of the training process, including needs assessment, task and job analysis, curriculum development, procurement and development of instructional materials, identification of consultants, training delivery and programme evaluation, besides being responsible for general management functions, including negotiation and cost aspects of any training programme. The parallel between this all-round training professional that ISVOR is developing at the training place and the multi-skilled, all-rounded electronics technician whom FIAT is attempting to develop at the workplace does not happen by chance. It reflects an understanding of the conditions necessary for the survival and permanent upgrading of a professional training organisation.

Staff development policies play a critical role in the Institute. However, such policies are mostly implicit and informal - even though they are strictly enforced. They are more easily found in the expectations and incentives - rather than through formal rules or formal requirements for training and updating. Examples might help clarify what these policies are, and how they operate. Personal development is considered an individual responsibility of each staff member. There are no formal training requirements or provisions for staff. Yet, self-development is considered vital and highly regarded. How? The staff are expected to keep abreast of development both in their own technical fields as well as in training methodologies. They are also expected to know and understand what is going on at FIAT's plants, as far as work technologies and working practices are concerned. The literature on the impact of expectations and psychological effects of learning on work performance is widely known and it should come

as no surprise to a reader that a leading training organisation uses such managerial practices.

Several strategies are used, all of which are embedded in the nature of the work, or in the way the work is performed. Training for the various functions described in the previous paragraph is mostly on the job. New staff members learn their work under the supervision of more senior staff, until they become independent course coordinators. A major source of professional self-development comes from the challenging nature of their tasks. As in the world of high tech, the world of high tech training requires trainers to be fully conversant with the latest developments in their respective fields if they are to provide any useful training at all. It is also expected that staff will be actively involved in academic and professional organisations.

Academic and professional, rather than bureaucratic criteria, are used to ensure staff involvement in these activities. This is a major departure from conventional training institutions, which tend to exert control over publications on the basis of political convenience, public image, marketing or industrial secret concerns. Of course there might be limits but the overall climate is one of transparence and free, professional and academic interchange.

Multidisplinary teams are also another instrument for permanent development of the staff: these teams provide trainers with an opportunity to see beyond their specialties, and to guage their own knowledge vis-à-vis their colleagues and the outside consultants brought in. In fact, by exposing themselves to high-calibre consultants they stand to learn a great deal. Another way of learning by doing is by working in collaborative projects. For example, a videodisk training programme on CAD/CAM techniques was jointly undertaken with a university in the United Kingdom and a media specialist, thus allowing ISVOR to learn in the process of interaction. Finally, it is part of the duties of trainers to update the contents, materials and methods of the courses under their responsibility on a regular basis.

The staffing policies and practices of ISVOR described above bear many parallels with the organisational culture of FIAT, and with the emerging cultural pattern of high-tech firms, in which organisational and individual learning become a matter of survival. In order to teach effectively, ISVOR is convinced that it must also be able to learn. In order to have professional trainers, ISVOR must hire the best professionals it can attract, and treat them accordingly. This sounds like a trivial statement - but it is seldom accomplished - particularly in training institutions, which more often than not become bureaucratic, routine, and far removed from the professional realities of the environment.

D. Costs and effectiveness

There are several possible ways to evaluate the costs and effectiveness of an institution like ISVOR. In practice, such possibilities are constrained by a number of caveats.

One could say that since all of ISVOR's technical training is performance based, the institute is 100% effective, because trainees only complete their courses when they adequately master the contents. This is probably true, but certainly not enough. Another method would be to evaluate the transfer of learning: how well or how quickly trainees adapt to their new functions. Indicators available are all very positive. So far, for example, all new plants or the ones which have been reconverted have been able to implement their plans on schedule and to start operations on time. Training has undoubtedly played a critical role, particularly in the high tech plants which depended on new work profiles. More, not less, training is demanded by plants, which can be interpreted as a success, rather than a failure of training.

More indirect ways would exist - for example - by estimating the savings obtained through training on items such as improvement of quality or shorter machine downtime. More rigourous data, however, are lacking, in spite

of the noticeable increase in product quality in the new and the reconverted plants.

ISVOR has no monopoly over training, so that we can talk about a market clearance mechanism as a criterion of evaluation. The Institute has hardly been able to meet demand from various units connected with the FIAT group, and for which it charges market prices. Even though the Institute aims at offering 25% of its capacity to sell services in the external market, it has been unable to do so, due to excessive internal demand for its services. It is true that it enjoys a privileged position as far as information, access and confidentiality is concerned - but the price to pay is also high: it is also expected to offer pre and post-sales services in the form of needs assessment, joint planning, evaluation and follow-up.

The costs charged by the institute are another indicator of its performance, as illustrated in Figure 11.

Figure 11

ISVOR in numbers, 1988

Total sales	US 40,000,000
Training days	23,000
Participants/days	350,000
Number of participants	33,000
Number of courses	650
Total Staff ISVOR	274

Several calculations could be made to estimate the relative efficiency of ISVOR vis-à-vis external suppliers of training, as reflected, for example, in the average cost per participant per day (slightly over 100 dollars). This is a very rough estimate, which has to take into account the fact that yearly income is partly invested in training materials that last for many years, as well as the fact that most of the training is intensive in the use of very expensive high tech equipment. Besides being competitive with market prices, ISVOR's training activities generate additional benefits and advantages. One of these most important of this is to incorporate, elaborate and disseminate the corporation's technological culture - which could hardly be provided by scattered providers of training.

For a corporation like FIAT where the state of technological upgrading requires intensive training investments, efficient training delivery becomes crucial. Training before implementation of a new plant or a new automation project - is usually financed by headquarters, and usually reaches 5% of total fixed initial investment. On-going training is entirely financed by the

operational budgets of the plants. It is an independent decision taken by plant and production line managers. In the highly competitive automotive business, such expenditures could only be justified by their actual results.

III. Concluding remarks

If ISVOR is unique to FIAT, the motivations to create it and the challenges it faces are common to many governments, countries, enterprises and training institutions. In these concluding remarks, we will focus our attention on two issues of broader interest: the changing of training institutions and the new challenges high tech brings to education and training institutions.

A. Managing change: continuity and rupture

ISVOR was not conceived in the abstract, nor does it operate in a vacuum. It is an integral part of the corporation's strategy. It is intimately related to corporate decisions concerning work organisation, work technology and training policies. Training is not an independent variable, but an integral part of a strategy of technological upgrading of the whole group.

Even though FIAT has been involved in training since 1922, it felt that its old training institutions would not be able to respond to the needs of the eighties. It was also unable to identify, in the existing educational and training institutions, a suitable response to its perceived needs. This is why ISVOR was conceived to replace the three former training institutions operated by FIAT.

ISVOR represented a major departure from the corporation's past training practices: new training objectives were introduced, new clienteles were included; training was no longer conceived as an option, but as a necessary investment, to be dealt with through a cost centre; full-cost recovery was introduced - training was no longer conceived as an optional free-good; curricula, methods and approaches to training were also dramatically changed - as were staffing patterns. Yet, ISVOR was not born from the ashes of its predecessors. Not only were buildings refurbished and staff trained and reconverted for the new approach. More than anything else, ISVOR inherited the intimacy with FIAT and its training needs. That gave it a clear advantage, and some sense of continuity, in spite of the rupture. Not all training institutes can be changed as easily as ISVOR - but this is a proof that training institutions can indeed change.

ISVOR was certainly a response to a transition. A transition in work technologies, a transition in management and training policies and practices. Existing alternatives were not suitable: in-plant training would be haphazard and generate high diseconomies of scale; at the same time the external suppliers of training were not ready to respond. Ten years later it is likely that the situation has changed - and most of the contents of the training provided by ISVOR can possibly be delivered by other institutions. Is this the direction to go?

Apparently not. Contents of training are only part of the story. By mimicking the corporate values and patterns of work, the Institute became able to perform other functions for the group, the more important of which is the transmission of corporate culture. It acts as an internal clearing-house, a cross-roads for exchange of information, technology and experiences outside the rush of the workplace. Formal training has thus become an effective vehicle for the development of the firm's technological culture, which is probably not an irrelevant externality.

What is important to conclude, however, is that the responsiveness of ISVOR is not only due to the ability of the institution to respond to challenges, but to the existence of the challenges. ISVOR did not create training needs - but

the other way around. It is only to the extent that training is a crucial component of technological change that institutions like ISVOR can survive, and thrive.

But ISVOR is certainly not the only response to FIAT's training needs - and that leads us to a discussion of how different societal actors may help to respond to new training demands brought about by new work technologies.

Who should train for high tech? High tech demands heavy investment in education and training. ISVOR only represents a partial - and to some extent a unique solution to the specific context of Italy and FIAT. However, the process of thinking through education and training responses is similar to other countries.

What does FIAT expect from the educational system? The response seems less spectacular than one might expect. FIAT authorities would like to see schools teaching exactly what schools have always been expected to teach: literacy, numeracy, the ability to communicate clearly and understand, the ability to think logically. But the corporation also expects schools to prepare youngsters for the world of work. They would like schools to transmit a realistic image of the workplace by explaining the economic functioning of society and the role of firms. And it also expects that students with higher and better habits of thinking and with more self-confidence in their ability to learn will be better prepared to accept and live with changes. This might not look a terribly sophisticated list of specifications - but most corporate authorities would be delighted if schools would transmit these abilities, values and attitudes to the majority of the student population.

It is important to note that FIAT does not hire its production employees from general, academic schools. For production functions, FIAT only hires graduates from vocational or technical schools - and expects to continue doing so in the future. The reason for preferring students with a technical, rather than an academic background is basically economic: it would take too much time (and money) to train people from scratch in basic skills. But the reason is also pedagogic: corporations are extremely narrow in their approach to training, and are not particularly fit to deliver general scientific and technological training and to provide the broad, scientific and technical basis now required for technical jobs in high tech firms. To some extent, this is what FIAT did before in its vocational training institute, and is no longer willing to do.

But as happened in relation to academic schools, the corporation's expectations regarding vocational and technical schools have also changed. FIAT does not expect graduates from these schools to be ready to operate its machines immediately after they leave school. This is not even desirable, to the extent that technological evolution requires industries to change their machines and products very often, within very short time delays. It would be financially impossible for these schools to keep changing their curricula and their workshops to mimic changes in industry. Moreover, it could be pedagogically disastrous if technical and vocational schools attempted to follow the pace of change of the most developed industries. What they are expected to teach, however, is the logic behind such changes, and how to cope with them, a higher level of understanding of general scientific and technological principles and applications, and, in some cases, the mastery of specific manual skills. The ability to learn and to apply scientific and technological concepts to practical situations seems to be the most valued skill when it comes to recruitment practices.

If these are the projected images for the world of the future, the role of a training industry like ISVOR would be that of an integrator. To some extent, this is what ISVOR has been attempting to implement, in various directions: integration of theory and practice; integration of different disciplines into a systematic view of the factory; integration of curricula to allow for vertical and horizontal specialisation, depending on the training trajectory of a given individual. The disciplines taught are basically the same as any technological institute, the mix

But ISVOR is still in a transitory phase, and most of its work force do not possess the basic skills required to cope with the demands of high tech. This is the reason for the present investments in retraining the workforce. As the level of entrants into the corporation rises, it might be expected that the duration and type of courses will also change, and concentrate on more applied, specific, integrated, and short-duration courses.

A question then arises whether corporate training institutions will continue to be necessary. Can't these functions be performed by external training institutions? Apparently the response is negative - given that the objectives of ISVOR go much beyond skill training. Outside training institutions could never instil the corporate values and the corporate technological culture that comes with training and human interactions.

Desirable as these training institutions might be, it is possible that in other countries other training arrangements will be required, in the form of training consortia or even public training institutions. Supporting the training activities of suppliers of machine tools and specialised equipment, in particular, seems to be a major gap which needs special attention. ISVOR illustrates a case in which most of these problems can be tackled by a big corporation. Other countries might have different solutions and organisational arrangements, but the problems they will face will probably be similar.

A final question arises. New graduates will be coming to the firm with higher levels of education and training. They will have learned how to learn, and be more flexible and adaptable to change. They will know how to read manuals, how to work in groups, how to take decisions under pressure. Will there still be a role for training? Would it still be necessary to maintain training institutions like ISVOR? Would other forms of training not be more effective - and efficient?

There are two realities going on in the FIAT plants and in ISVOR which provide the beginning of an answer. We saw that ISVOR is primarily a training institution. But we also saw that in order to teach effectively, ISVOR's staff have to learn even more than they teach. They learn about the evolution of their areas of specialty, they learn about FIAT and FIAT's adopted technologies. The training they provide becomes increasingly closer to the workplace - training and work seem to be converging.

Factory workshops are also becoming a place to learn. Learning and doing are becoming increasingly more integrated. Engineers learn from technicians, who learn from operators, who learn from suppliers. People learn through manuals, in quality circles, through projects of productivity improvement. As illustrated in the first figure, the learning curve of the world of high-tech is one in which learning and doing are becoming increasingly intertwined. ISVOR, in its relationships with FIAT, illustrates the convergence of the worlds of doing and learning and may thus provide a glimpse into how the future will look for training and high tech training institutions.

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